Revised

Geomorphology and Habitat of the Tailrace Slough Study Plan for Energy Northwest's Packwood Lake Hydroelectric Project FERC No. 2244 Lewis County, Washington

Submitted to

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1.0 INTRODUCTION

Energy Northwest's Packwood Lake Hydroelectric Project, FERC No. 2244, received its initial license in 1960. The majority of the Project is located within the Gifford Pinchot National Forest and consists of an intake canal, a concrete drop structure (dam) and intake building on Lake Creek located about 424 feet downstream from the outlet of Packwood Lake, a 21,691-foot system of concrete pipe and tunnels, a 5,621-foot penstock, a surge tank, and powerhouse with a 26,125 kW turbine generator.

The source of water for the Project, Packwood Lake, is a natural lake situated at an elevation of approximately 2,857 feet above mean sea level (MSL), about 1,800 feet above the powerhouse. Water discharged from the Project is delivered via a tailrace channel to a slough (i.e., tailrace slough) which then enters the Cowlitz River. Power from the Project is delivered over an 8,009-foot 69 kV transmission line to the Packwood substation.

1.1 Study Goals and Objectives

The goals and objectives of this study are to obtain a description of the physical habitat present in the tailrace slough; the geomorphology of the point bar at the end of the tailrace; and the likely changes in the point bar and tailrace slough over the duration of the license, including:

1. Likely physical changes to the tailrace slough over the course of the license (natural processes);
2. Potential for development (residential or industrial) of area surrounding the tailrace slough; and
3. Potential for Energy Northwest to undertake activities to stabilize (i.e. rip rap, grading) or otherwise modify the tailrace and its entrance into the slough over the course of the license.

Although Energy Northwest will review the potential for development of the area surrounding the slough by reviewing Lewis County zoning documents, this area is private property and is currently being developed for residential use by others. Energy Northwest will maintain the property associated with the tailrace, however it has no control over the activities of Lewis County and other property holders in the slough area.

2.0 AGENCY AND TRIBE RESOURCE MANAGEMENT GOALS AND OBJECTIVES

NOAA Fisheries and the U.S. Fish and Wildlife Service (USFWS) requested this study. The relevant resource management goals are given below.

2.1 NOAA Fisheries Management Goals and Objectives

NOAA Fisheries has responsibility and authority under the Federal Power Act, 16 U.S.C. §791 *et seq.,* the Endangered Species Act, 16 U.S.C. §1531 *et seq.,* and the Magnuson-Stevens Fishery Conservation and Management Act, 16 U.S.C. §1801 *et seq.*, to manage and protect anadromous salmonid populations.

The Lower Columbia River Salmon Recovery Plan (LCFRB 2004) has identified these specific recovery goals for salmonid populations in the lower Columbia Basin:

2.1.1 Adult Population Productivity and Abundance

1. In general, viable populations should exhibit population growth rate, productivity, and abundance that, in combination, demonstrate an acceptable probability of population persistence. Various approaches for evaluating population productivity and abundance combinations may be acceptable, but must meet reasonable standards of statistical rigor.
2. A population with non-negative growth rate and an average abundance approximately equivalent to estimated historic average abundance should be considered to be in the highest persistence category. To demonstrate this criterion, studies should include a credible estimate of historic abundance, an estimate of current abundance averaged over several generations, and an estimate of growth rate done with adequate statistical confidence.

2.1.2 Juvenile Migrant Production

The abundance of naturally produced juvenile migrants should be stable or increasing as measured by observing a median annual growth rate or trend with an acceptable level of confidence.

2.1.3 Within-Population Spatial Structure

The spatial structure of a population must support the population at the desired productivity, abundance, and diversity levels through short-term environmental perturbations, longer-term environmental oscillations, and natural patterns of disturbance regimes. The metrics and benchmarks for evaluating the adequacy of a population's spatial structure should specifically address:

1. Quantity: Spatial structure should be large enough to support growth, abundance, and diversity.
2. Quality: Underlying habitat spatial structure should be within specified habitat quality limits necessary to support life history activities (spawning, rearing, migration, or a combination) taking place within the patches.
3. Connectivity: Spatial structure should have permanent or appropriate seasonal connectivity to allow adequate migration between spawning, rearing, and migration patches.
4. Dynamics: Changes to the spatial structure should not harm its ability to support the population. The processes creating spatial structure are dynamic, so structure will be created and destroyed, but the rate of flux should not exceed the rate of creation over time.
5. Catastrophic Risk: The spatial structure should be geographically distributed in such a way as to minimize the probability of a significant portion of the structure being lost because of a single catastrophic event, either anthropogenic or natural.

2.1.4 Within-Population Diversity

Sufficient life-history diversity must exist to sustain a population through short-term environmental perturbations and to provide for long-term evolutionary processes. The metrics and benchmarks for evaluating the diversity of a population should be evaluated over multiple generations and should include:

1. Whether substantial proportion of the diversity of a life-history trait(s) existed historically,
2. Whether gene flow and genetic diversity is similar to historic (natural) levels and origins,
3. Whether there is successful utilization of habitats throughout the habitat; and
4. Whether populations show resilience and adaptation to environmental fluctuations.

2.1.5 General Habitat

1. The spatial distribution and productive capacity of freshwater, estuarine, and marine habitats should be sufficient to maintain viable populations identified for recovery.
2. The diversity of habitats for recovered populations should resemble historic conditions given expected natural disturbance regimes (wildfire, flood, volcanic eruptions, etc.). To the extent possible, diversity should be measured against historic conditions. Historic conditions represent a reasonable template for a viable population; the closer the habitat resembles the historic diversity, the greater the likelihood that it will be able to support viable populations.
3. At a large scale, habitats should be protected and restored, with a trend toward an appropriate range of attributes for salmonid viability. Freshwater, estuarine, and marine habitat attributes should be maintained in a non-deteriorating state.

2.2 USFWS Management Goals and Objectives

2.2.1 General goals

1. Ensure that protection, mitigation and enhancement measures are commensurate with Project effects and help meet regional fish and wildlife objectives for the basin.
2. Recover federally proposed and listed species.
3. Conserve, protect, and enhance the habitats for fish, wildlife, and plants that continue to be affected by the Project.
4. Ensure that once the licensing process is complete, there is an adaptive management plan to allow the use of new information or new management strategies over the term of the license, bringing us closer to the desired level of protection for fish and wildlife resources. The adaptive approach is particularly appropriate where there are insufficient data and/or biological uncertainties about those measures that will be most effective for meeting ecosystem goals and objectives.

2.2.2 Goals for Aquatic Ecosystems

1. Protect, enhance, or restore diverse high quality aquatic and riparian habitats for plants, animals, food webs, and communities in the watershed and mitigate for loss or degradation of these habitats.
2. Maintain and/or restore aquatic habitat connectivity in the watershed to provide movement, migration, and dispersal corridors for salmonids and other aquatic organisms and provide longitudinal connectivity for nutrient cycling processes.
3. Restore naturally reproducing stocks of native anadromous and resident fish to historically accessible riverine habitat, using stocks that are native to the Cowlitz River basin where feasible, with priority given to the restoration of listed native stocks.
4. Provide an instream flow regime that meets the spawning, incubation, rearing, and migration requirements of wild salmonids and other resident fish and amphibian species, throughout the project area.
5. Meet or exceed federal and state regulatory standards and objectives for water quality in the basin.
6. Minimize current and potential negative project operation effects on water quality and downstream fishery resources.

2.2.3 Goals for Endangered, Threatened and Proposed Species

1. Reduce project effects on bald eagles, spotted owls, and other threatened, endangered, and proposed species.
2. Explore opportunities for potential protection, mitigation and enhancement measures for threatened, endangered, and proposed species.
3. If bull trout are discovered within the Cowlitz River basin, gain a better understanding on bull trout population trends, migration, habitat loss, present usage and continuing impacts as related to the Project.

In addition, an overarching USFWS goal for the new licensing of the Project is to succeed in having the Commission include, as license conditions, protection, mitigation and enhancement measures that sustain normal ecosystem functional processes including geomorphic, hydrologic and hydraulic patterns, and water chemical and physical parameters. Maintaining and improving these functional processes throughout the term of the new license will, in turn, provide the habitat to support healthy fish and wildlife populations.

The USFWS indicates that its study requests are intended to facilitate the collection of information necessary to conduct effects analyses and to develop conservation measures, reasonable and prudent measures, and protection, mitigation, and enhancement measures pursuant to the Endangered Species Act (Act) of 1973, as amended (16 U.S.C. § 1531 *et seq.),* the Fish and Wildlife Coordination Act (48 Stat. 401), as amended, (16 U.S.C. § 661 *et seq.),* and the Federal Power Act (FPA) (16 U.S.C. § 791a, *et seq.).*

3.0 EXISTING INFORMATION AND NEED FOR ADDITIONAL INFORMATION

No complete physical habitat survey within the project tailrace slough has been performed. There was an anadromous spawning survey conducted, which noted some general physical characteristics of the tailrace slough (EES Consulting 2005). There is a plunge pool and associated tailout located at the downstream end of the lined portion of the tailrace. The current tailrace slough is approximately 400-800 feet long between the end of the lined tailrace and the confluence with different portions of the Cowlitz River channel (See Figure 5-1). The Cowlitz River channel changes frequently, altering the configuration of the slough.

3.1 Need for Additional Information

In order to understand Project impacts on salmonids, a survey is needed to determine the physical characteristics of the tailrace slough and how the slough may interact with the Cowlitz River as it moves across its channel migration zone. Channel changes in the slough can affect resident and anadromous fish species in the area. In addition, the study will help determine the extent of potential fish stranding and redd dewatering in the tailrace slough when Project flows are reduced or shut off.

4.0 NEXUS BETWEEN PROJECT OPERATIONS AND EFFECTS ON RESOURCES

The Project tailrace is an integral component of the Packwood Lake Hydropower Project. Salmonids have been observed in the tailrace slough, which connects the tailrace to the main channel of the Cowlitz River. The slough is directly affected by project operations. The tailrace slough cuts through a point bar on the Cowlitz River. The Cowlitz River is a glacial river with a high sediment load. The point bar is part of this dynamic system, with frequent channel changes and channel migration. Evaluation of the geomorphological characteristics of the area will allow proper assessment of possible actions by the applicant over the course of the license that may alter the slough and its value as salmonid habitat.

5.0 STUDY AREA AND METHODS

5.1 Study Area

The study area includes the tailrace slough from a point 500 feet upstream of the end of the lined tailrace downstream into the Cowlitz River to the end of the project boundary (from approximately the point labeled A33 to the point labeled A39 on Figure 5-1).

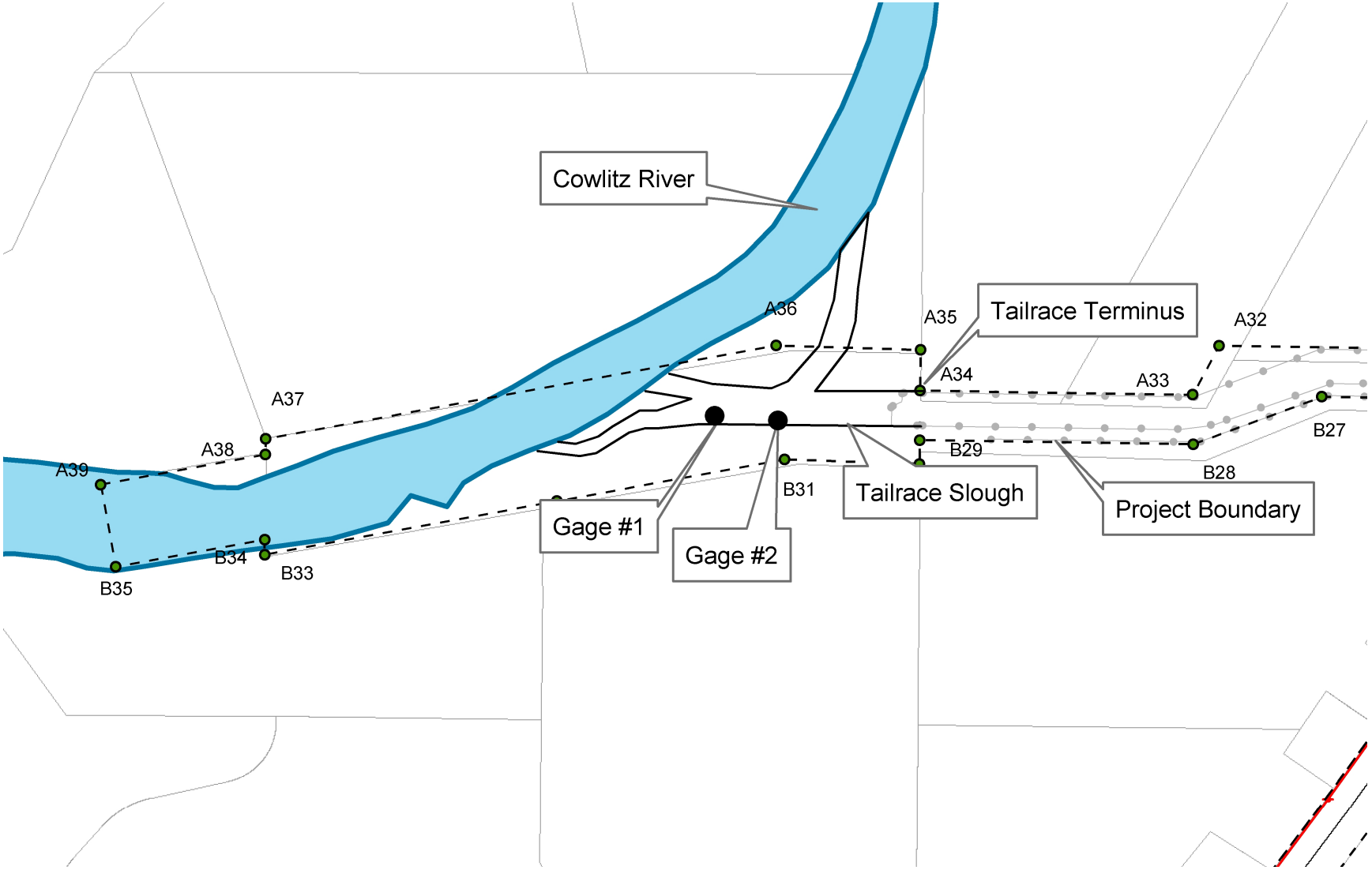

Figure 5-1. Study Area

5.2 Summary of Modifications to Study Methods Requested by NOAA Fisheries

An analysis of channel changes in the Cowlitz River based on a series of historic aerial photographs was substituted for the longitudinal profile in the Cowlitz River to better understand the channel dynamics in the area. A visual assessment of the grain size distribution of sediment at each cross section was substituted for samples at each cross section; pebble counts will be made at five cross sections in the slough. This information will adequately describe variations in grain size.

5.3 Tailrace Survey and Geomorphic Analysis

The following methods will provide information on the historic channel changes in the tailrace slough area as well as current conditions and potential future natural and human-induced changes.

An analysis of the Cowlitz River and tailrace channel changes through time in the vicinity of the tailrace slough will be made from historical aerial photographs of the area. This will provide information on the past migration zone of the Cowlitz River channel, frequency of channel changes, and likelihood of future changes. Changes in the Cowlitz River are unrelated to project operations, but affect the tailrace.

A survey of the site by a geomorphologist will be conducted using the protocols and methodologies similar to Harrelson et al (1994) to characterize physical habitats within the tailrace slough:

a. Measure a longitudinal profile from the downstream end of the tailrace as indicated on the project boundary map (points labeled A39/B35 on Figure 5-1), through the river and tailrace slough area, and 500 feet into the lined portion of the tailrace (to approximately the point labeled A33 on Figure 5-1).
b. Measure cross sections every 50 feet along the length of the longitudinal profile of the existing tailrace slough channel (from upstream end of longitudinal profile through the slough to the confluence with the Cowlitz River). Cross sections should extend as far as necessary on both sides of the tailrace channel to include appropriate natural and manmade features. Appropriate features should include, but not be limited to the following: rip rap, levees, roads, side channels, and the historic Cowlitz River channel migration zone (abandoned channels). Measure partial cross sections (approximately every 100 feet apart) of the portion of the Cowlitz River channel between the existing outlet of the tailrace slough and the downstream end of the project boundary. These partial cross sections would extend from the base of the existing rip rap on the south side of the Cowlitz River channel up and over the rip rap through the historic channel migration zone and would include the natural and manmade features.
c. Visually estimate the grain size distribution of sediment at each cross section. Conduct pebble counts (100 clasts) at five cross sections within the existing tailrace slough.
d. Describe and mark on overlays to the most recent aerial photograph (or a sketch map if the channel has changed since the photos were flown) shoreline features of the tailrace slough and adjacent riverbank area, including the rip rap that is located adjacent to the

tailrace slough that was placed after the lower portion of the tailrace was washed away. At a minimum include in this description the following: year and reason rip rap was placed, amount placed, future planned management, length, slope, top and bottom width, height, particle sizes, and the presence of wood, riparian vegetation, or other material within the rip rap.

e. Prepare a map showing the principal physical structure and habitat features found in items a through d, including surrounding land use and ownership.

Property ownership, zoning and development plans that are likely to affect the point bar and tailrace slough area will be reviewed. An assessment will be made of the potential need for Energy Northwest to modify the tailrace as it enters the slough or surrounding area over the course of the license. The assessment will include possible actions and their likelihood over the course of the license, including the reconstruction of an adult fish barrier in the tailrace.

5.4 Products

A report summarizing the results of the field inventory and analysis of past and potential future natural and human-induced changes to the tailrace slough area will be prepared.

5.5 Consistency with Generally Accepted Scientific Practice

The survey of the tailrace slough is consistent with channel survey methods used by the USDA Forest Service. Analysis of channel changes on historical aerial photographs has been used in numerous other FERC license studies, including the Cowlitz River Project and the Lewis River Projects.

6.0 CONSULTATION WITH AGENCIES, TRIBES AND OTHER STAKEHOLDERS

Energy Northwest initiated agency consultation in December 2003. A Water Quality and Aquatic Resources Committee was formed in March 2004. Representatives include Energy Northwest, EES Consulting, Watershed GeoDynamics, WDFW, USFWS, NOAA Fisheries, Department of Ecology, the Forest Service, the Cowlitz tribe, and the Yakama Nation. Agencies, tribes, and other stakeholder representatives will be invited to participate in meetings, provide information for the study, and conduct technical reviews of the draft report.

7.0 PROGRESS REPORTS, INFORMATION SHARING AND TECHNICAL REVIEW

Technical reports, including the draft and final reports will be shared with agencies, tribes, and stakeholders. Energy Northwest and its consultant will also report on the methods, progress, and results of the study at stakeholder meetings.

Energy Northwest will provide copies of the draft report to interested stakeholders for review. Review periods will be 30 days, after which Energy Northwest and its consultant will take review comments into consideration when making revisions and producing a final report.

8.0 SCHEDULE

The survey of the tailrace slough area will take place during low flows in 2006. A draft report will be prepared by November 30, 2006.

9.0 LEVEL OF EFFORT AND COST

The level of effort includes finalization of the study plan, study implementation, and report preparation as well as consultation with agencies, tribes and stakeholders.

The level of effort to complete the field survey is anticipated to be 3 field crew days (field crew includes geomorphologist and field tech working 10 hour days). Level of effort to compile and analyze the field data, prepare a map, write a draft and final report and consult with stakeholders is estimated to be 10 days.

Total level of effort for all tasks in this study plan is 17 person days with a total estimated study cost of approximately $15,501.

10.0 LITERATURE CITED

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